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# DACHS 1
# LUBRICATING OIL PLANT
# PORTA, GERMANY

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COMBINED INTELLIGENCE OBJECTIVES
SUB-COMMITTEE

LONDON - H.M. STATIONERY OFFICE

# DACHS-I

## (UNDERGROUND LUBRICATING OIL PLANT)

## PORTA (NEAR MINDEN), WESTPHALIA, GERMANY

Reported by

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on behalf of

British Ministry of Fuel and Power

and

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on behalf of

United States Technical Industrial
Intelligence Committee

CIOS Target No. 30/217
Fuels and Lubricants

COMBINED INTELLIGENCE OBJECTIVES SUB-COMMITTEE
G-2 Division, SHAEF (Rear), APO 413

JPEG

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## Personnel of Team

16 April 1945

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17 and 18 May 1945

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## DACHS I (UNDERGROUND LUBRICATING OIL PLANT

## PORTA (NEAR MINDEN), WESTPHALIA, GERMANY

### Introduction

This is an underground plant for producing aviation lubricating oil from topped crude oil to be supplied from the Hanover area. It is located in an old sandstone quarry just back of the railroad station at Porta, near Minden, in Westphalia, Germany; Army map P. 3 (Detmold), Scale 1/100,000, coordinates 807052. The main entrance to the plant (as of 18 May 1945) is shown in Figure 1.

The existence and location of this plant were disclosed to Mr. Oriel's party in April 1945, by Dr. von Eynatten, Manager at Misburg and Freiheir Heeremann, the manager of the Lubricating Oil Plant at Misburg. Similar information was disclosed independently on 10 May 1945, to the second party who investigated the plant, by Prof. E. Terres, Director of Edeleanu Gesellschaft, during an interview at his temporary offices in Altenburg, Germany.

### Personnel

Dipl. Ing. Arnold Schroder, a Hollender, was in charge of the installation of the various units. During May 1945 he was in charge of feeding the inmates of a large Displaced Persons camp in Minden on the west side of the Weser. Mr. Schroder was formerly in charge of the Refining Department of Uhde Gesellschaft für Hochdrucktechnik, Boevinghausen, near Dortmund (Ruhr), and was detained by the Nazis for refinery construction. He had also previously worked with Wickham and Morlander of the M. W. Kellog Co. In Fig. 1 he is to be seen in the center foreground.

Mr. Schroder was interviewed on May 17, 1945 and served as guide through the plant on May 18, 1945. He also suplied the attached sketch of the plant layout, which is substantially in agreement with a sketch supplied to Mr. Oriel by Heeremann.

## Plant Condition

The office at Porta was opened and organized on August 4, 1944, to plan necessary further excavation of the old sandstone mine and construction of the plant, which was to be built under the Geilenberg plan by the Todt organization. Thus, all work was carried out under the direct supervision of the SS.

The plant was approximately 90% complete with 95% of the equipment on location; installation would have been complete in an estimated 6 weeks from the date of occupation by our troops. All records and plans were removed by the SS two days before the occupation took place and Schroder said they probably were in Hanover and that full information should be obtainable from a Dr. Weller, Manager of NERAG (Neu Erdöl Raffinerie A. G.) at Misburg, near Hanover. On the other hand, Mr. von Eynatten, who was said to be Manager at Misburg, stated to Mr. Oriel's party that all plans had been in the hands of the Todt organization at Porta itself.

Due to lack of ventilation and to the water seepage, most of the iron and steel equipment was rapidly rusting.

## Plant Operating Units

The plant consisted of five units as discussed hereinafter. The in-place value has been estimated at £500,000 ($2,000,000).

## Distillation

This was to be carried out in a two-stage Coubrough unit, the heaters and columns having been moved to this location from the Nerag Refinery at Misburg. The primary stage had a capacity of approximately 9000 tons/month of topped crude which was to be brought by tank car from the Hanover district. The first column was to take a naphtha cut overhead and side streams of Diesel oil and neutral oil. The bottoms were to be charged with naphtha in equal volume proportions to the second column at some reduced pressure, where a heavy cylinder oil cut was to be taken overhead, reducing the bottoms to approximately 20% of asphalt. The Diesel oil, wax, and asphalt were shipped out and, so far as known, used without further treatment. A small amount of piping was required for completion.

## Extraction

The neutral and bright stocks were to be furfural extracted for the work up of aviation lubricating oils. This unit was designed by Still G.m.b.H., Rechlinghausen, near

Höxter-am-Weser, and apparently was of usual design. Installation of pumps, piping and insulation was incomplete.

## Dewaxing

This unit is one of the most recent designs of Edeleanu Gesellschaft, using methylene dichloride and ethylene dichloride as solvents followed by a continuous band filter. The filter was a new and interesting development. There were four such filters, of the latest improved design, which were constructed by R. Wolf of Magdeburg. This unit required some insulation for completion. An earlier model of this continuous band filter had been in use at the A.G. Sächsische Werke at Espenhain. Some detailed drawings of the filters used in Dachs I were evacuated from the files of the Edeleanu Ges., at Altenburg.

## Clay Contacting

Following the dewaxing and solvent recovery, the oil was to be batch clay contacted in quite conventional manner. These contactors and filters were also brought in from the NERAG refinery at Misburg. These oils were to be blended and used without further treating.

## Clay Extraction

This plant was to be located outside the mountain and was simply to consist of a batch naphtha extraction of the used clay from the contacting to recover the last traces of lubricating oil. The oil, after flashing off the gasoline, was to be sold or used as motor oil without any treatment.

## Auxiliary Equipment

Concrete tanks inside the mountain provided working tankage (4,000 $m^3$ total) whereas the feed and product storage was to be in bunkers on the mountain side.

A small steam plant had been constructed outside the mountain and was ready for operation. It was designed for 35 tons/hr. of 22 atm. steam. This plant had been constructed for use of the Philips Company which was located 50-60-m. higher in the sandstone layer. The Philips company was to manufacture radio tubes and, although it had not operated before occupation, the Military Government at Porta had directed it to start production.

Two other steam plants were to be constructed in the mountain. Although installations had not been started, all the parts were on the site and it was estimated that it would require six weeks for completion.

Water for the plant was to be supplied by four pumps at the Weser River which would deliver 400 $m^3$/hour each at 12 atm. pressure. The water discharge was to flow back to the Weser through an open sluice.

It was further planned to seal up the main opening (Fig. 1), through which the units had been brought, with approximately eight feet of concrete as bomb protection. In this same tunnel, the offices and control laboratories were to be built.

A single blower in the rearmost tunnel was to provide necessary ventilation. By the use of sealing doors on cross tunnels and vents, the air was to be drawn in two of the lateral tunnels and blown out the other two (see Fig. 2). This installation was incomplete.

J. A. Oriel
W. A. Horne
J. P. Jones

# PORTA

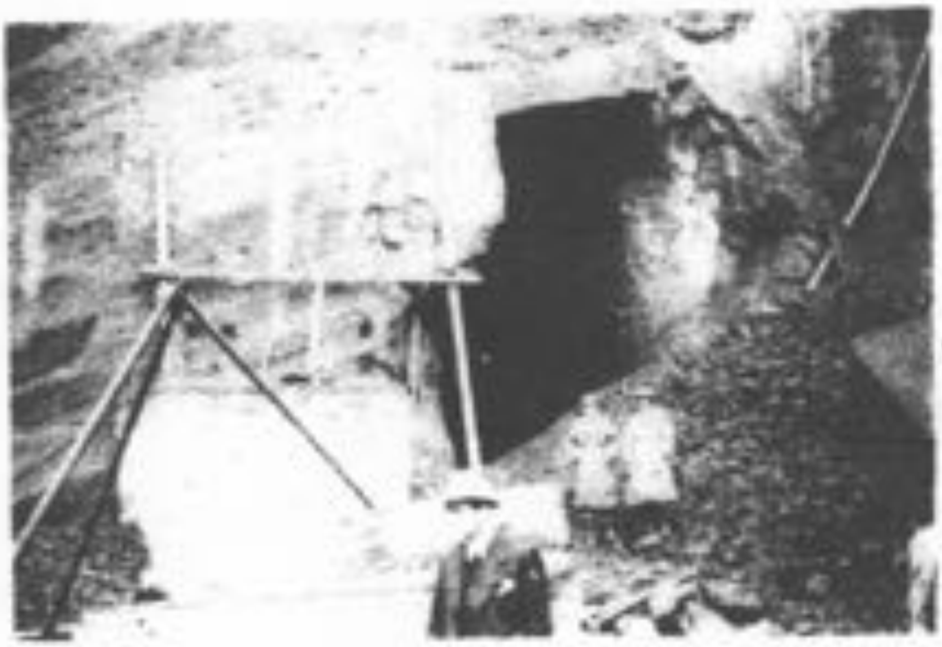


Figure 1

Dachs 1. - Main Entrance
Center Foreground - Arnold H.W.A. Schroder
Sup't. of Construction and In
Charge of Construction and In
Charge of Refining Department
for Uhde G.m.b.H.

## DACHS I

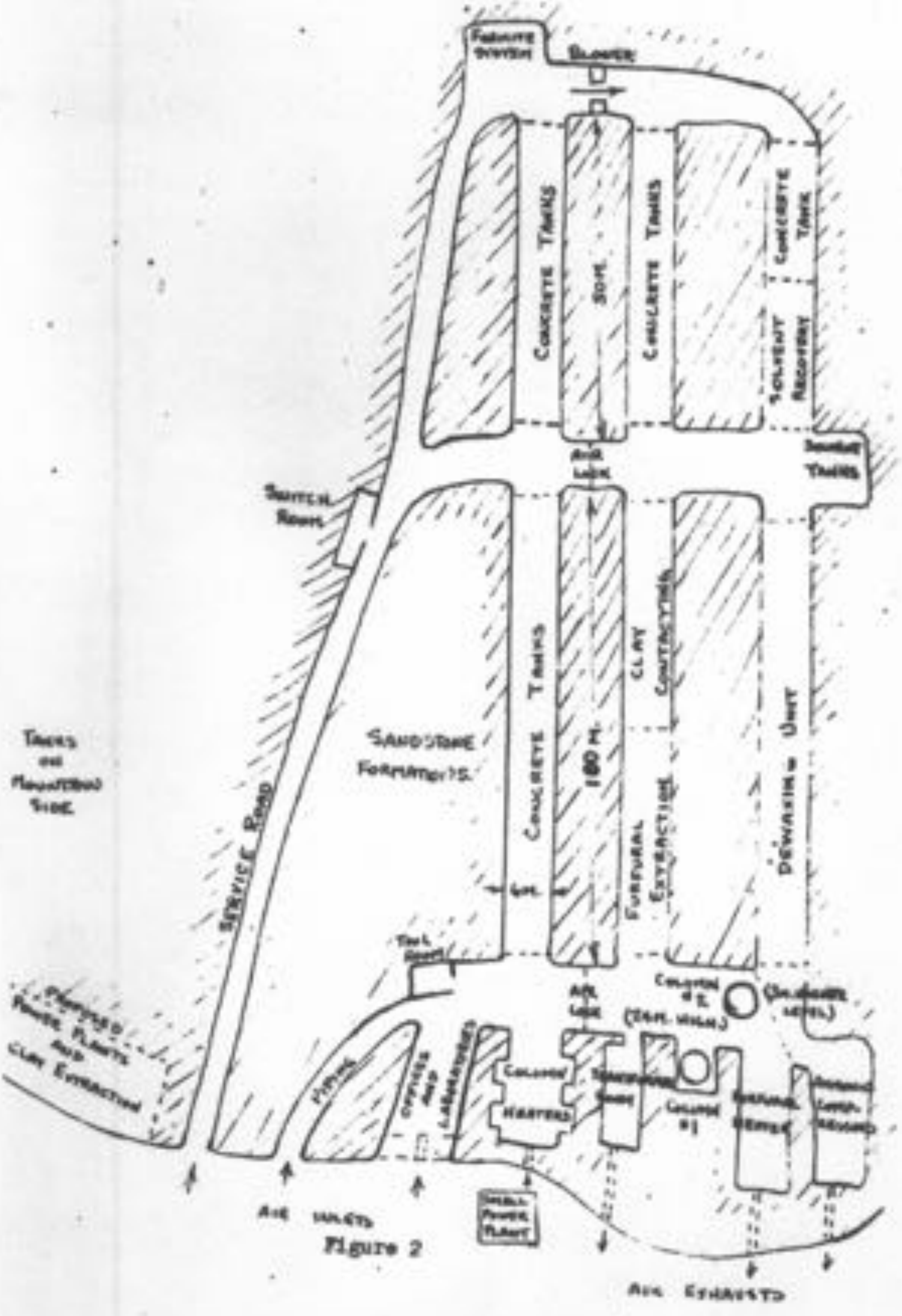


Figure 2

The site was not visited and the above information was obtained from Herr R. Rautenbach and Herr H. Rautenbach, directors of the Industrie Kontor, and from Herr Sendler of Thale Ironworks.

### (J) A/28. Denkmal Stollen: Barkhausen Porta Westfalica, near Minden

C21/1329
C22/3468
C31/8

The Denkmal Stollen was a factory of the multi-storey type construction in an old freestone quarry on the west wide of the Weser valley, near Minden. The quarry consisted of a single chamber about 90 metres long. 12 metres wide, and 17 metres high. The work of conversion was carried out departmentally by the Government. There was no additional excavation, but three reinforced concrete floors with access stairways were installed, and a concrete blast wall built at the entrance. Conversion work is said to have started in the autumn of 1943 and to have been completed in the middle of 1944. No details of labour, costs or progress could be obtained.

The second and third floors had been occupied by "Antrupa" from Aachen for the manufacture of "Panzerfaust" components, the first and ground floors were used for the manufacture of ball bearings by the firm of Dr. Ing. Boehme & Co., Metallwarenfabrik, Minden-Lubbecherstrasse.

## CONTACTS & REFERENCES

The following Germans were interrogated:-

Herr Roettgen, Assistant Production Manager, and Herr Bodenmuller, Production Engineer, for Dr. Ing. Boehme & Co.

The Site is described in:-

Air Ministry Interpretation Report No. U.19 (Cross Bow) 31.1.45, Prussian Geological Survey, Sheet 2016, 1/25,000, Minden 1930 and Memoir 1933.

## GEOLOGY

The area is underlain by sedimentary rocks of Jurassic age striking east and west and dipping to the north at about 20°. The outcrop of comparatively resistant sandstones is marked by a range of hills about 900 feet high running east and west for about 20 miles, through which the river Weser flows in a water gap known as the Porta sandstone. It is a massive moderately coarse grained calcareous sandstone 40 metres thick, in the outcrop of which underground freestone quarries have been worked on both sides of the gap.

The Porta Sandstone is overlain by clay shales, the so called, Ornatentone, and is underlain by the Cornbrash, which were seen in the railway access tunnel to Dachs I on the opposite side of the valley consists of thinly bedded limestone.

In the Denkmal Stollen there were no signs of rock falls, but it was observed that the roof of the gallery near the entrance was in an unsafe condition.

## LAYOUT OF FACTORY

Plans of the factory are attached to this report. (Figs. 7A & 7B).

## LINING & SUPPORT

On the ground floor a concrete wall 1 metre high and 9" thick was formed against the side of the gallery, the top of this was dished to form a channel for moisture running down from above. Elsewhere the natural rock was whitewashed.

A ceiling of wall-board and timber was built beneath the roof of the quarry.

## ENTRANCE

A blast wall of concrete 1.3 m. thick was constructed at the entrance to the quarry. (Photograph No. 20). There was a main entrance on the ground floor with openings at each storey for hand materials.

## WATER SUPPLY

Water from the municipal supply was pumped to two small storag tanks near the factory.

## SEWAGE

Sewage was water-borne, and discharged crude into the River Weser.

## AIR ATTACK

There were no signs of air attack on this factory.

ENGINEERING SERVICES

(a) Heating

The Boiler House was excavated in the cliff face near the main factory entrance, and contained three cast-iron sectional low pressure steam boilers.

The steam generated was taken to an air heater battery used for the main factory ventilation, a second heater battery for stores, and to several items of plant requiring process steam. The condensate was returned by gravity in a closed system.

Coke was initially delivered to the factory by lorry and subsequently delivered by narrow gauge railway into an outside fuel bunker. From this bunker it was barrowed on to the top of the boilers and dropped into top firing doors.

(b) Ventilation

The main factory ventilation comprised a heated fresh air supply and an extraction system, each having a main duct at the ceiling level of the 3rd floor. Air delivered to one of these ducts through a heater battery by means of an intake fan of the double entry type. This fan was located in a sealed chamber and drew air from outside at the cliff face through a simple spray washer and horizontal spray eliminator plates. The water sprayed in the washer was taken from the main water supply and rejected to waste.

It was noted that no valves or thermostatic controls had been provided, and the control of air temperature was effected by proportionate bye-passing of the air heater as necessary. The water spray was intended to give a degree of cooling in hot weather only, and it was not used during the winter months.

The following information regarding the optimum heating and ventilating conditions was obtained by interrogation:-

(1) Relative humidity 58 to 65%.
(2) Temperature 65 - 72°F.
(3) 8 air changes per hour

The maintenance of the stated relative humidity was obviously not possible, nor necessary, in the cold weather.

From the main supply duct at third floor ceiling level and which was constructed in building board, air was distributed to the various floors by means of vertical drops in painted sheet metal, and was discharged through adjustable outlets near floor level. On the opposing walls, vertical risers with inlets at high level of each floor were taken to the exhaust main trunking, also made in building board, at third floor ceiling level. The discharge drops were staggered in relation to extraction risers.

On the third floor near the entrance, an additional installation had been provided comprising supply and extract fans, with ducts and a heater battery forming a simple plenum heating and extraction system for the separate chambers offset from the main tunnels.

(c) Electric Power and Lighting

The main supply was taken from a 6,000 volt feeder and transformed to 380/220 volts, 3 phase. The main low tension switchroom was adjacent to the Boiler House and distribution cables were carried on boards supported from transverse concrete beams by hangers. Very little metal conduit work was used except for risers passing through floors and in these instances protection was afforded to a height of 4'6" above floor level.

In general, the lighting comprised metal filament lamps with enamelled iron industrial type reflectors and all circuit wiring was carried out in the form of surface cleat work.

No systematic earthing arrangements appeared to have been provided.

(d) Compressed Air

Compressed air at 6 atmospheres was supplied by two small vertical reciprocating compressors, one for standby, sited on the ground floor, as shown in drawing attached. Cooling water from these compressors was run to waste.

Compressed air was mainly used for pneumatic chucks for holding bearing rings for radius turning, and also for clearing swarf from machines.

PRODUCTION & LAYOUT

This factory comprised four storeys built in the side of a hill. The ground and first floors had been devoted entirely to the production of ball bearings, the second and third floors having been used for the manufacture of a detail for the Panzer Faust (Bazooka). Access was by door on the ground floor with stairways connecting each floor for employees use.

For goods service, an electric lift of 2,000 kilogram capaci was installed, serving all floors. Additional to this a clearway had been cut in the first, second and third floors, giving an openi of about 6' x 10' with an overhead beam with hand operated lifting block secured to the roof of the third floor. This had obviously been used for handling of plant of a heavy nature, particularly during the period of installation. Internal transport was effecte by hand, augmented where essential with battery driven floor truck External transport to and from the factory was by means of lorry only, the approach road being bad and having a very steep gradient.

It was understood that this factory started production in September, 1944, and it is estimated that the total labour force wa about 400/500 spread over two 12 hour shifts. Two thirds of the labour would have been foreign workers.

The drawing attached indicates how factory floors were arranged, i.e. immediately above each other and also showsthe formation of the tunnels. All tunnels were unlined, the walls being whitewashed.

## Ball Bearing Section

The bearings manufactured were of the non-precision type, ranging from 5/8" to about 2" diameter. Although the complete assembly was undertaken at this factory, the balls were obtained from Schweinfurt (or elsewhere) and the cages from the parent surfac factory at Minden.

With regard to output, the Production Engineer stated that th were aiming at 350,000 completed bearings per month, but on further questioning he stated that the maximum output reached was 250,000 completed bearings per month. He also gave a total output of 3,000,000 bearings up to the time that the factory stopped producing, but this is considered to be an impossible figure having regard to the fact that the factory had only been producing for a period of six months. Making allowances for the embryo stages our assessment is more in the neighbourhood of 1/1½ million.

No provision had been made within the factory for storage of bar stock, other than alongside the respective automatics, and deliveries of bars were no doubt made at irregular intervals owing to transport difficulties. It is not only possible but very likely that there were times when production of certain sizes of bearings had to be temporarily eased owing to lack of material.

All single and multi-spindle automatics were installed on the ground floor and in an inclined formation of about 27° to the longitudinal axis of the tunnel, thus giving a clearance on one side of about 3' and a gangway at the other side of about 5'.

The bearing races were produced from the bar (not forgings) and the multi-spindle autos comprised one 60 m.m. 4-spindle Hasse & Wrede, five Pittler 4-spindle machines - two of which were 52 m.m., two of 42 m.m., and one 22 m.m. capacity, one 6-spindle Pittler of 22 m.m. capacity. The single spindle autos of which there were three, were 2G Brown & Sharpes. The Hasse & Wrede 4-spindle auto was unduly heavy and unwieldy for the class of work required, and the opinion was formed that this machine, owing to its stroke, was originally designed for small shell production. The question of the absence of a machine of the rotary surface grinder type was taken up with the Production Engineer, who stated that they had had to resort to finishing after hardening by lapping operation only; on further questioning he stated that a Naxos Union rotary surface grinder was on order, but although completed at the maker's works, it could not be delivered owing to transport difficulties.

A swarf breaker and oil extractor had been installed and sited near the tunnel entrance on the ground floor, but as no special arrangements for the removal of swarf existed it was clear that this could only have been done at such times as were convenient. Swarf, after treatment in the oil extractor, was removed to a stock external to the factory where advantage had been taken of a short run of rail track left by the constructional engineers.

In view of the fact that the tunnels were unlined and the ventilating system was by bottom inlet and top outlet, the question of inclusion of dust or grit into the machine tools was discussed and we were assured that they had had no trouble from this source. This claim no doubt was true since apart from the fact that tunnels were whitewashed, the presence of oilmist from the autos and the absorption of oil in the floors would to a large extent overcome this difficulty as compared to conditions where the grit and dust is in free suspension in the atmosphere.

Opinion was expressed that having regard to the formation of the tunnels and the type of ventilating system installed, the oilmist arising from the use of a large number of multi-spindle automatics would create an unpleasant atmosphere. It was claimed, however, that this difficulty had been overcome by the introduction of a deodoriser into the cutting oil up to the extent of ½%. Details of the deodoriser were not available, but this was known as "Konsotal" and had been supplied by a Dr. Hammer of Deutche Gasolin, Hamburg.

It was ultimately intended to transfer the production of cages from firm's surface factory to Minden to this underground factory but they would still have been dependent on supply of balls from other sources.

All hardening was by electric furnaces, and these, together with their dipping tanks, were installed in separate chambers offset to the first and second floor main tunnels.

Print attached shows the layout of automatic machines installed on the ground floor for ball bearing production.

Detail for Panze Faust (Bazooka)

This detail involved the cutting of a tube, insertion of a plug, welding the plug and then subsequent machining operations. Although at the time of visit all machine tools had been removed, the machining operations were obviously very simple and would have presented no difficulty, but here in this particular portion of the factory a welding room had been partitioned off at the blind end of the tunnel on the third floor, and having regard to its area - 36' x 22' - and the fact that it contained fourteen welding booths together with a storage rack sited in the centre of the room and which in itself occupied an area of about 18' x 2'6", opinion was formed that apart from the restriction in space, the atmosphere and working conditions in this room with all booths occupied would have been very undesirable, particularly having regard to the long hours worked per shift. Ventilating in this room was on the general principle of bottom inlet and top extraction, and would not have compensated for the conditions which would prevail when operators were working simultaneously in all welding booths.

(X) PORTA WESTFALICA
Oil Refinery in the Arminsberg, south of Minden
Code Name: DACHS I.

C21/1330
C22/1034
C31/1201

This factory, a wartime enterprise, was intended as a refinery for the treatment of topped crude oil from the Hanoverian field. At the time of our visit it was about 90% complete. It is of particular interest owing to the size and complexity of the plant which was installed underground, as can be seen in photographs Nos. 23 and 25.

The factory is constructed from underground quarries in the Porta sandstone, but these were greatly enlarged to accommodate the plant. Railway access to the plant was intended (Photo. No. 1) but was not completed.

Excavation was started in March 1944. The planning of installation was started in August 1944, and installation of plant started in October 1944. It is said that the plant was within six weeks of completion at the end of the war; a remarkable achievement.

## Contracts and References

The following were interrogated: Herr Schroder, (Dutch, English speaking) previously employed by the firm of Fr. Uhde A.G. of Dortmund, as engineer on plant installation, now employed by the Military Government.

Herr Pott, Mining engineer, Manager of the Gewerkschaft Porta, a firm working iron mines near Haverstadt. This firm carried out all tunnelling work in the Porta Westfalica area.

Further information will be found in:-

(a) C.I.U. Report, ref: U.19 dated Jan. 1945, including air photographs, plan and geological sections.

(b) U.S.S.B.S. Advance Field Assessment Report No. 5 dated 14/15/16 April, 1945.

(c) Report prepared by C.E. Branch. I Corps District, dated 29th May, 1945.

(d) Assessment Report by Commander P.G. Springer U.S. Navy, dated 15th April, 1945.

(e) Report from 307 P.Mil.Gn.Det. to 21 Army Group (D.P.) C.P.L. "Report on Lubricating Oil Refinery, Dachs I". Ref.307/172-/Z/7 5th July, 1945.

It is probable that more detailed information could be obtained from Herr Schroeder and Herr Pott, from the staff of the Misburgh Refinery, Hanover, and details of the Furfurol Extraction Unit from the Still Co., Recklinghausen who were responsible for its design and construction.

## Geology and Site Investigations

The geology of the district has already been described in section J. At Dachs I all workings except the railway tunnels were confined to the Porta Sandstone. This stratum is 40 m. thick, and dips to the North at 20°. Owing to this dip the headroom within the sandstone increases to the south and advantage was taken of this to suit the layout of the plant.

We were informed that no detailed site investigation was necessary as the staff of the constructors, the Gewerkschaft Porta, had a thorough knowledge of the geology of the district.

No falls of roof were seen in the factory area, but a heavy fall was seen in the railway tunnel where this traverses the

"Cronbrash". This tunnel was supported by steel ribs and timber laggings.

## Layout of Factory

Plans of the refinery and of the proposed system of railway tunnels are given in this report. Cross sections are also given, and the cover against air attack is described in Appendix 1.

## Volume of Excavation

The completed work amounted to 62,000 cu.m.

## Floor Area

The total floor area completed was 4,500 sq.m.

## Labour Data

The total labour on the construction of Dachs I and the Adjacen Hammerwerke factory including the installation of plant, was 4,000 to 4,500; of these 2,000 were German (mostly craftsmen) the remainder wer civil prisoners 1,100 of whom came from concentration camps; they included Russians, French, Poles, Italians and Letts.

Total labour on civil-engineering work at Dachs I was 450, labour on actual tunnelling consisted of 50 men per shift, 3 shifts a day, made up of miners and concentration camp labourers.

## Progress data:

The progress made is difficult to arrive at as the work was carried out in conjunction with the nine storey Philips factory adjacent known as Hammerwerke.

## Cost data:

The total cost of structural and installation work at Dachs I and Hammerwerke was 15 million marks, of this 2 million marks covered the cost of underground excavation which was made up as follows:

| | | | |
|---|---|---|---|
| (1) | Preliminary works | 50,300 | |
| (2) | Excavation of 1st section of Tunnels A.B. & C. 34,000 c.M. | 644,102. | 80 |
| (3) | Excavation of 2nd. section of Tunnels. Extensions to A.B. & C and parallel tunnels 20,500 c.M. | 384,331. | 45 |
| (4) | Excavation for Boiler House 4,000 c.M | 224,128. | 13 |
| (5) | Dayworks, 3,500 c.M. | 292,158. | 88 |

| | | | |
|---|---|---|---|
| (6) | Welfare, travelling expenses, etc. | 74,299. | 36 |
| (7) | Overhead charges | 180,250 | |
| (8) | Machinery charges and maintenance | 70,200 | |
| (9) | Recovery of plant and materials | 8,000 | |
| | | 1,927,770 | 62 |

The contract was based on 58,000 c.M. of excavation at 19 marks per c.M. Special excavation in the boiler house by hand labour, 4,000 c.M. at 55 marks per cubic meter and 3,500 paid at daywork rates plus 76%. Herr Pott stated that this returned a nett 20%.

Excavation

The methods used differed in no way from those already described mechanical loaders including the Saltzgitter Lader, the Schrapper Lader and Belt Conveyors were used, Herr Pott stated that the Schrapper Lader was the most flexible and that maintenance charges were heavy on the Saltzgitter Lader.

The steel sharpening shop was well equipped with mechanical sharpeners, oil fixed furnaces and automatic tempering device.

Spoil was transported by standard gauge locomotives and wagons.

Lining

The factory tunnels were unlined and sprayed with whitewash, though in places brick walls were built to carry structural loads. The partly constructed railway tunnel was lined with steel ribs and wooden laggings where it traversed thinly bedded limestones.

Special points at the entrance of galleries: None

Shafts: None

Water supply: Pumped from river Weser in addition to tapping local supplies.

Sewage disposal: Linked up with sewage disposal from Phillips factory gravitation system. After treatment discharged into river.

Miscellaneous

It was of great interest to see plant as large and as elaborate as that required for oil refining housed in underground workings, for this suggests that there are few industrial operations which cannot be carried on underground if necessary.

Other features to be noted are the great size of the workings, some as much as 90 feet high, and the immunity to air attack given by the choice of site.

Finally the rapidity with which the design and construction of the work was carried out is most remarkable.

## Engineering Services

### (a) Heating

In view of the nature of the proposed production for this factory viz. oil refining, no arrangements had been made for heating the incoming air. The main problem obviously was to remove the heat resulting from the process operations.

### (b) Process Steam

High pressure steam was required for process and for this purpose two boiler houses were under construction inside the workings with access at road level in the cliff face. The constructional work for these boiler houses was not sufficiently advanced to suit the anticipated commencing date for production consequently one boiler had already been delivered and erected temporarily in an old quarry close to the workings, together with steam mains and provision for picking up the permanent boiler houses when completed. It was intended to erect the second boiler in its permanent boiler house and when in a condition to accept the load, the first boiler was to be dismantled and re-erected in its own permanent boiler house.

The boilers were of water tube type, with single steam drum and water cooled furnace walls. It was stated that the furnace was designed for burning crude oil, gas from the Rhur grid system, or asphalte, but it was admitted that no experience had yet been gained on the last named type of fuel, and it was anticipated that difficulties would have been met. The boiler pressure required was 330 lbs./sq.inch although these particular boilers were capable of developing a pressure of 500 lbs./sq.inch.

A lime soda feed water treatment plant had been erected beside the boiler in the quarry, but it was not clear whether this was to be duplicated within the tunnel workings or to be allowed to remain outside.

### (c) Ventilation

For the proposed ventilation of the complete installation it was intended to instal one main axial flow fan (alleged duty 5,000 cubic metres per minute) at the rear of the tunnel network and with the fan chamber so arranged as to draw air through one half of the workings and to discharge through the second half.

It was evident that great reliance was being placed on the heat given off by the process plant, motors, etc. to keep the humidity under control.

When the factory was inspected, a temporary fan was exhausting to atmosphere near the cliff base, but was quite inadequate for maintaining any perceptible air movement, except in the near vicinity of the fan.

Observations taken during the inspection were as follows:

Dry bulb temperature 57°F
Wet bulb temperature 56°F

Deeper in the workings there was complete saturation with condensation everywhere.

(d) Electric Power and Lighting

The electric power supply was obtained from an outside source at 25,000V and two transformers each of 2,500 KVA transforming from 25,000V to 6,000V had been installed. Two additional transformers each of 1,000 K.V.A. capacity had also been provided for transforming from 6,000 to 400V; these transformers were located inside the workings and were enclosed in well built cubicles with fan ventilation (inlet at bottom and outlet at top).

It was understood that this transformer station also supplied electric power to the Philips factory in the adjacent workings at higher level.

(e) Services Generally

The installation of services was well advanced, and represented in total a tremendous achievement in planning, erection and the co-ordination of trades.

Economy of space for cables, pipes etc., had been rigidly observed and full use has been made of multi-purpose service gantries, cantilever supports and vertical box type assemblies for orderly distribution of services.

Massive cross bearers at high level and spanning the full width of the chambers were used for the heavier pipes.

Overhead runways had been provided for handling plant components and the larger vessels had been built up in either welded or riveted construction in situ.

The whole of the installation was deteriorating rapidly with the excessive humidity condition of the air as already observed under the section dealing with ventilation.

Production and Layout

This plant had been installed underground and was intended to deal with 300 tons of topped crude oil per day. The installation within the workings was about 90% complete, the remaining 10% of work yet to be done involved the completion of the internal production storage tanks and general. inter-connection of pipe lines.

Since this factory has already been the subject of a comprehensive report in Subject:- (Oil Refinery NN/903/5, Reference 307/1724/P dated 29th May, 1945) there is no need to add further detail. Nevertheless, we would express the opinion that the installing of this plant underground was an engineering feat of no mean order, particularly since it was essentially standard equipment and not subjected to any major modifications. For general reference we have added a plan of the workings and indicated thereon the areas allocated to the various refining operations.

(L) HAMMERWERKE FACTORY, near Hausberg
Porta Westfalica, Minden

C21/1331
C22/3469
C31/2809

This factory, of the multi-storey type, was constructed in underground quarries on the East side of the Weser gap south of Minden. The quarries were situated in the Porta Sandstone above the Dachs I Refinery, and had been enlarged by the Gewerkschaft Porta to house the Phillips Radio Valve factory from Eindhoven, in Holland.

Constructional work is said to have started in March, 1944 and to have been completed in September, 1944. Production started in February, 1945.

Contracts

The following were interrogated:-

Herr Goossens, engineer, Dutch, speaks English.
Herr Pott, mining engineer, manager of the Gewerkschaft, Porta.

Herr Haupt, formerly engineer on plant installation,
now custodian of the factory for the Military Government.

Geology

The geology of the area has already been described in the sections dealing with Dachs I and Denkmal Stollen. The Hammerwerke factory nine storeys high was constructed in the Porta sandstone (photograph No. 21) and being south of Dachs I was at a higher level as a result of the dip of this stratum as can be seen in the geological section attached to this report (Fig.8A.) The two factories were to have been connected by an internal shaft.

There was no evidence of rock falls in the factory area.

Lining & Support

The workings were for the most part unsupported and the rock surface only whitewashed. At a few points steel joists and timber laggings had been used.

Excavation

The little excavation done on this site was carried out simultaneously with Dachs I and no separate data was available on labour, costs or progress.

Entrance

The main entrance, on the seventh floor, was protected by a blast wall of concrete 1.1 metres thick, and was connected with the main road at Hausberg by a funicular railway.

Water Supply

Process water was pumped from the River Weser. Water was available from the town supply.

Sewage Disposal

Sewage was disposed by gravity into the Weser after treatment.

Air Attack

There was no evidence of air attack on this site.

Engineering Services

(a) Heating

The Boiler House was located on the surface at road level adjacent to the entrance of the Porta (Dachs I) factory.

The boiler was of the horizontal type in three sections:-

1. Cornish boiler design with corrugated flue.
2. Section comprising smoke tubes
3. Smoke box section.

Steam was taken off the middle section, which was also provided with dead weight safety valve, and thence proceeds to the super heater section located round the crown of the smoke box.

Steam and condense mains were taken through the entrance of the Dachs I factory and thence by means of a sloping tunnel up to the ground floor of the Hammerwerke Factory and to the various steam heater batteries associated with the ventilation plants.

(b) Ventilation

Six separate plenum extract systems were installed, all of similar character and dealing with the floors in groups. Each system draws fresh air from, and discharges vitiated air to, the cliff face.

Each inlet system comprised a main inlet fitted with a wire grill leading into a concrete spray chamber thence to an eliminator and finally to the fan chamber. The water sprays were not connected, but it was clear that they were to be supplied with water from the main supply and that this water would be rejected to waste.

Two types of delivery fans were used -

1. Double inlet type in an enclosed fan chamber following spray and eliminator chamber.
2. Single inlet fan with duct connection to the spray and eliminator chamber.

Each inlet fan discharged into a main delivery duct constructed in building board, at the respective ceiling level, and vertical metal ducts were taken down to floors as required with adjustable discharge openings near each floor level.

Vertical extraction ducts with inlets at high level, as required, were connected to a main extraction duct, also constructed in building board, running adjacent to the corresponding main fresh air delivery duct. The main extraction duct was connected to the extraction fan chamber and thence to atmosphere. At the time of the inspection all fans were running but heater batteries and water sprays were out of commission. Condensation was evident on the lower floors but the general state of the factory suggests that production heat energy in conjunction with the use of steam heater batteries had resulted in a reasonable air condition.

(c) Electric Power and Lighting

The electric supply was taken from the sub-station at Porta (Dachs I) at 6,000 volts and the high tension cables were brought up through the service tunnel and taken to four transformer stations. The voltage was then transformed from 6,000 volts to 400 volts 3 phase 4 wire, each of these transformers was rated at 800 KVA.

Low tension feeder cables were taken as risers to metal closed cabinets containing main switches, fuses, circuit breakers and relays.

Circuit wiring was taken at high level and in general was supported by a series of galvanised multi-strand steel cables which also served as an earthing wire collectors. Each steel cable was thoroughly bonded to the rising watermain.

Drops to machines and table inspection lights were taken from special metal junction boxes with porcelain interiors.

All metal parts and components were earthed on to the galvanised straining cables by means of single strand cables, approximately No. 18 gauge.

An attempt was made by interrogation to gain information regarding the type of earth leakage system installed but the only information offered was that every power unit had a leakage trip and that transformers were earthed at the star point.

The general illumination and local bench lighting were of a high standard for example 4 kilowatts of lighting load has been installed in an inspection bay approximately 25' x 25'.

(d) Fire Protection

Fire hydrants complete with hose reels were provided in metal cabinets fixed to walls and connected to the rising waterman. Portable fire extinguishers were also provided.

(e) Gas Installation

Gas for process work was obtained from the town supply and the installation followed conventional standards for the class of work under consideration.

Production and Layout

This factory consisted of nine floors with layout as shown on the attached print and situated in the same hill as the Oil Refinery, Dachs I, which is the subject of a separate report. This factory was first put into operation in February, 1945 when it was intended to reinstate the production hitherto obtained from Philips Eindhoven factory, Holland. All plant and equipment, even down to the inspection benches and stools, were transferred from Eindhoven. This factory was very impressive in so far that there was ample spacing, and lighting was particularly good.

The ultimate production was to have been 12,000 radio valves per day, but it was ascertained that up to the date of ceasing production, some 7,000 serviceable valves only had been issued. Thi in no way represents the total number of valves actually manufactured since it was made clear by the Production Engineer (Dutch) that the number of defectives was considerable and this in the main was due to inclusion of dust at the final assembly stages. It should be appreciated that this dust trouble would not be discernible by casual observation. Nevertheless, the question of dust did not apparently interfere with the manufacture of component parts nor did it affect work carried out in the tool room and maintenance shop. Walls had been whitewashed but not otherwise treated or lined.

The total labour force spread over three shifts would have been 1,200/1,400, the vast majority being females, mainly young Jewish girls from concentration camps. Three shifts were arranged viz:- two of 6 hours, and one of 8 hours, the break coming between 3.0 a.m. and 7.0 a.m.

Production arrangements were as follows:-

1st floor - Toolroom and general maintenance shop. This plant was in first class condition, amply spaced and machines were of first class make, including several American tools such as Gorton and Milwaukee Milling machines. This floor also housed the gas mixing plant required in production and was distributed to the required stations on the other floors by normal pipe distributing system.

2nd floor - This was essentially devoted to grid rolling and all the requisite plant for this operation had been installed and its condition was good.

3rd floor - Allocated to component assembly. This floor was also used as a main stores for component parts.

4th floor - Mainly for assembly and testing.

5th floor - This was laid out for the drawing of filament wires and testing, but it was obviously not yet in full production. A side gallery on this floor was occupied by a separate firm, Carsten of Hamburg, who were apparently responsible for stamping out the mica parts which were subsequently used by Philips in the assembly.

6th floor - Had no defined use at the time of visit, except for a few offices and it was understood to have been used as sleeping quarters.

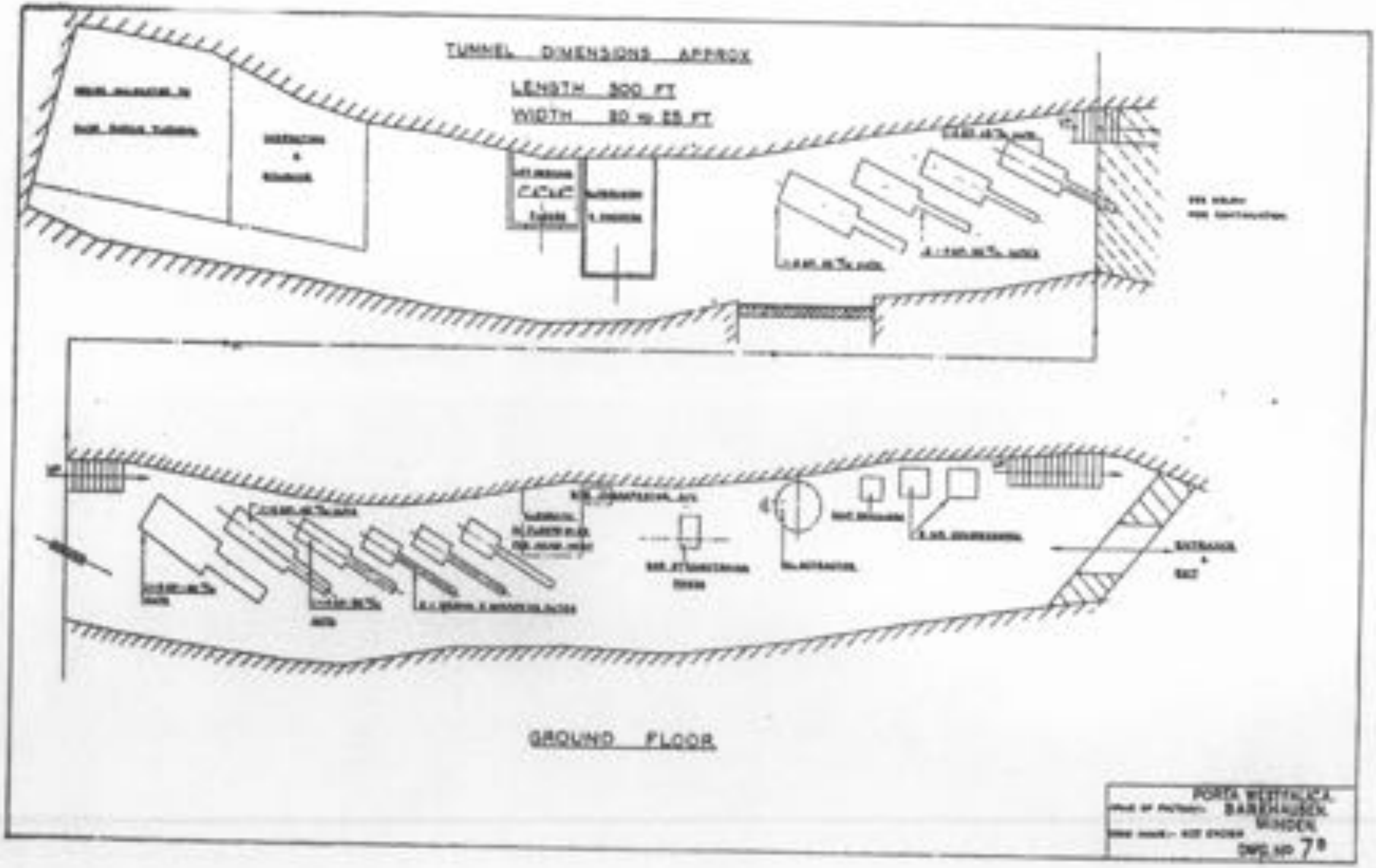
7th floor - This was the main entrance and exit for the whole factory, and contained a certain amount of plant for preparation of cathodes and filaments.

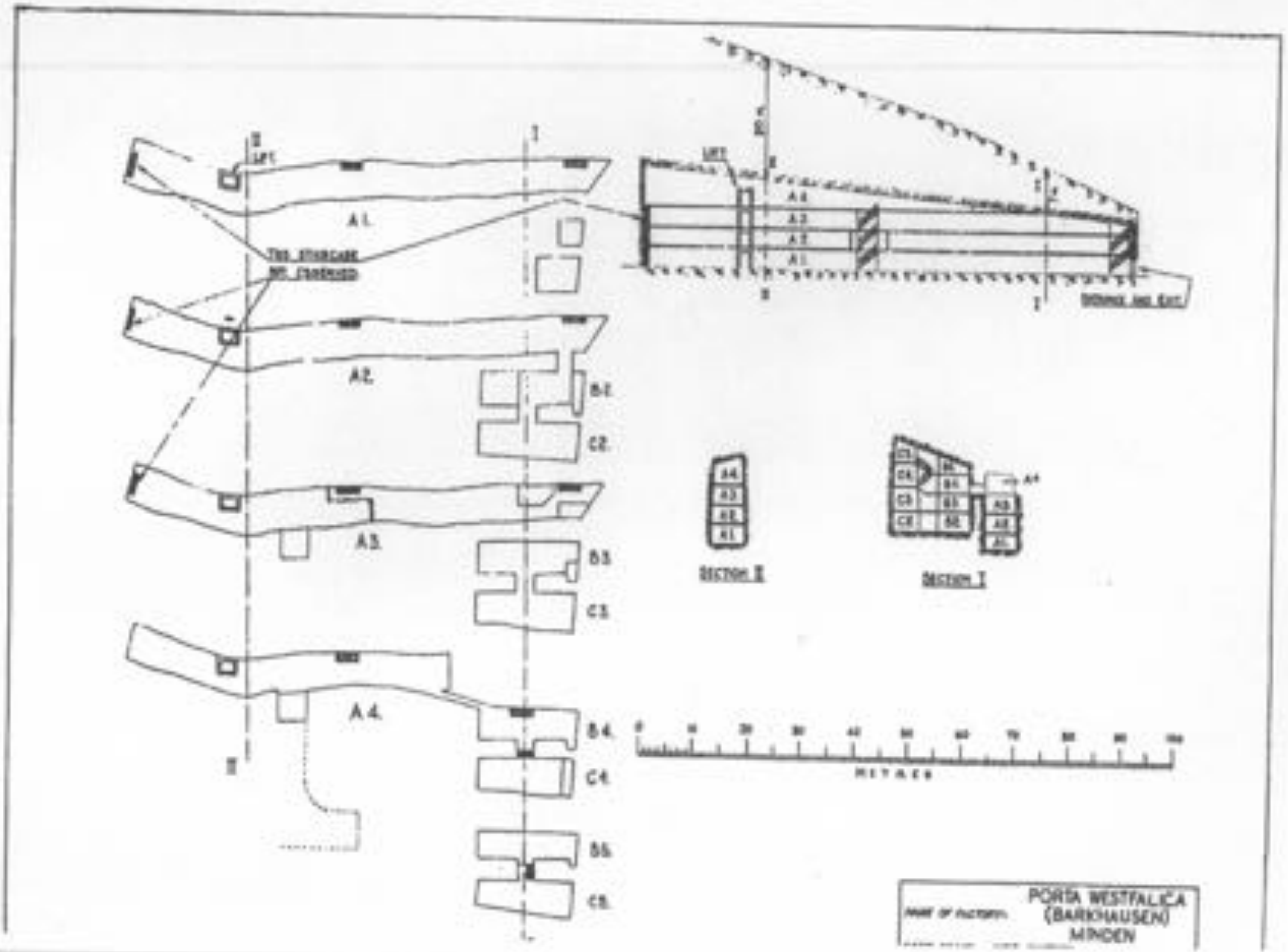
8th floor - Preparation of cathodes and filaments.

9th floor - This was used for offices and ablution, and had a small exit probably used by staff only.

Access for employees to the respective floors was by stairway, and for goods, a lift 4 x 3 metres and having a capacity of 5,000 kiligrams was installed to serve floors 1 to 7.

The only external access provided to this factory from the main road was by means of a funicular railway which terminated at the level of floor 7 and about 200 ft. from the tunnel entrance.


TUNNEL DIMENSIONS APPROX
LENGTH 300 FT
WIDTH 20 to 25 FT
UP
ENTRANCE & EXIT
GROUND FLOOR
PORTA WESTFALICA
BARKHAUSEN
MINDEN
DWG NO 7B


II
LIFT
I
A1.
THE STAIRCASE
NOT FINISHED
A2.
B2.
C2.
A3.
B3.
C3.
A4.
B4.
C4.
B5.
C5.
II
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A4
A3
A2
A1
II
I
ENTRANCE AND EXIT
A4
A3
A2
A1
SECTION II
C1
C4
C3
C2
B4
B3
B2
A4
A3
A2
A1
SECTION I
0
10
20
30
40
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60
70
80
90
100
METRES
NAME OF FACTORY:
PORTA WESTFALICA
(BARKHAUSEN)
MINDEN

PHOTOGRAPH No.1. Temporary support for railway access tunnel to DACHS 1.

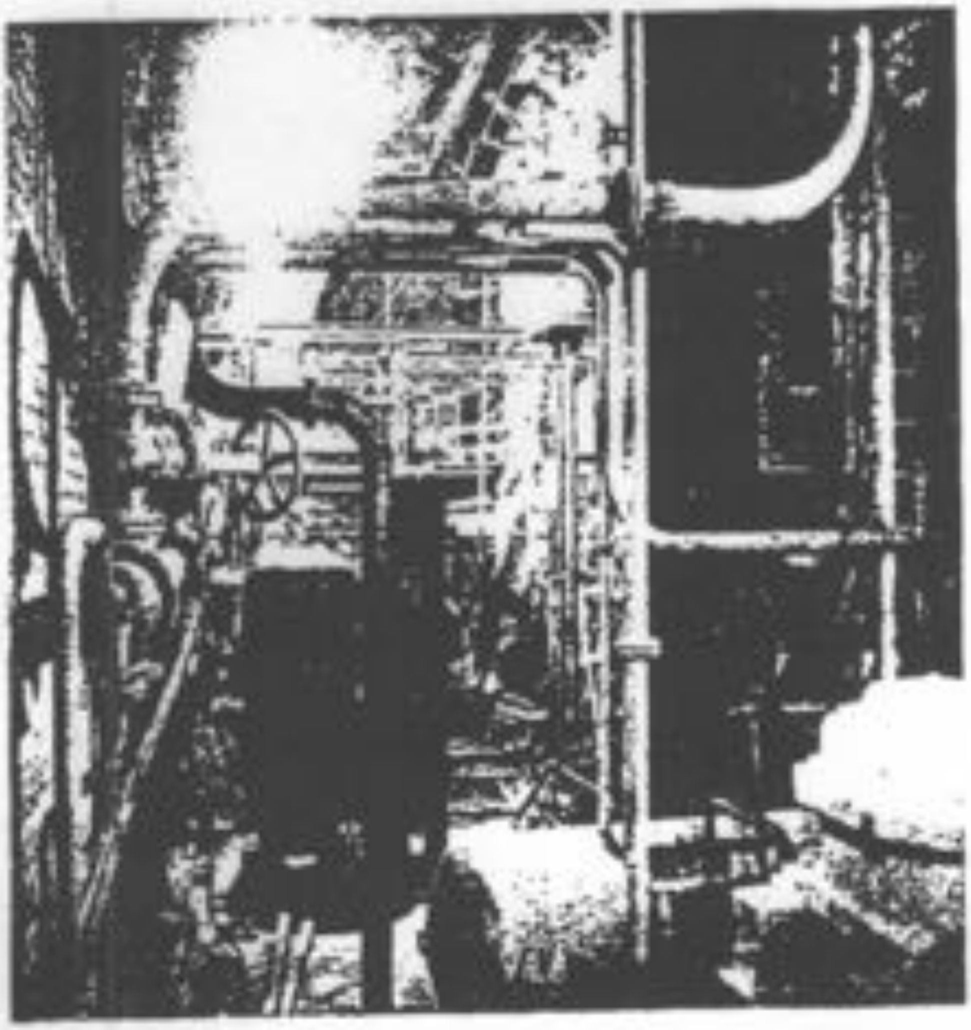
PHOTOGRAPH No.36.

Hammerwerke,
Porta Westfalica.

Funicular railway from the entrance to Hammerwerke. Entrance to Dachs I below, River Weser in distance.

PHOTOGRAPH No.27.

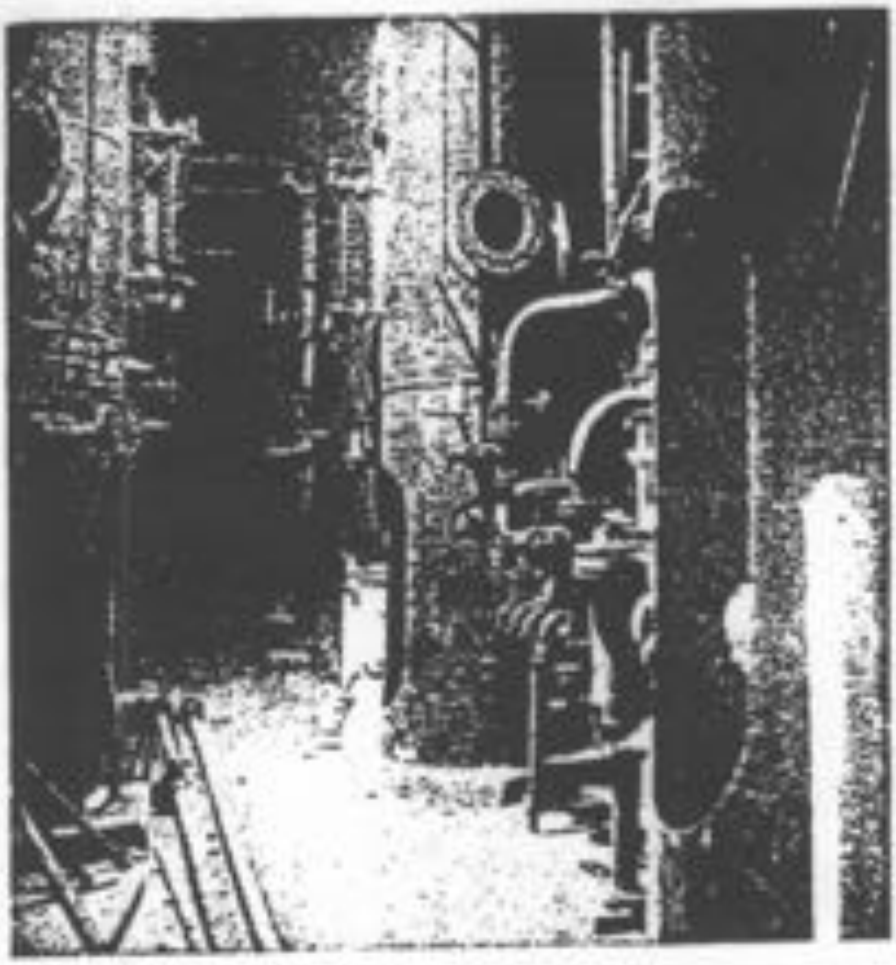
Hammerwerke,
Porta Westfalica.



PHOTOGRAPH No.

Dechs I,
Porta Westfali

Oil Refinery



PHOTOGRAPH No.23.

Dachs I,
Porta Westfalica.

Oil Refinery.

PHOTOGRAPH No.24.

Dachs I,
Porta Westfalica.

Entrance to oil
refinery in Porta
sandstone,
Ornatentone above.

PHOTOGRAPH No.22.

Denkmal Stollen, Barkhausen.

Groundfloor. Note roof construction.

PHOTOGRAPH No.20.

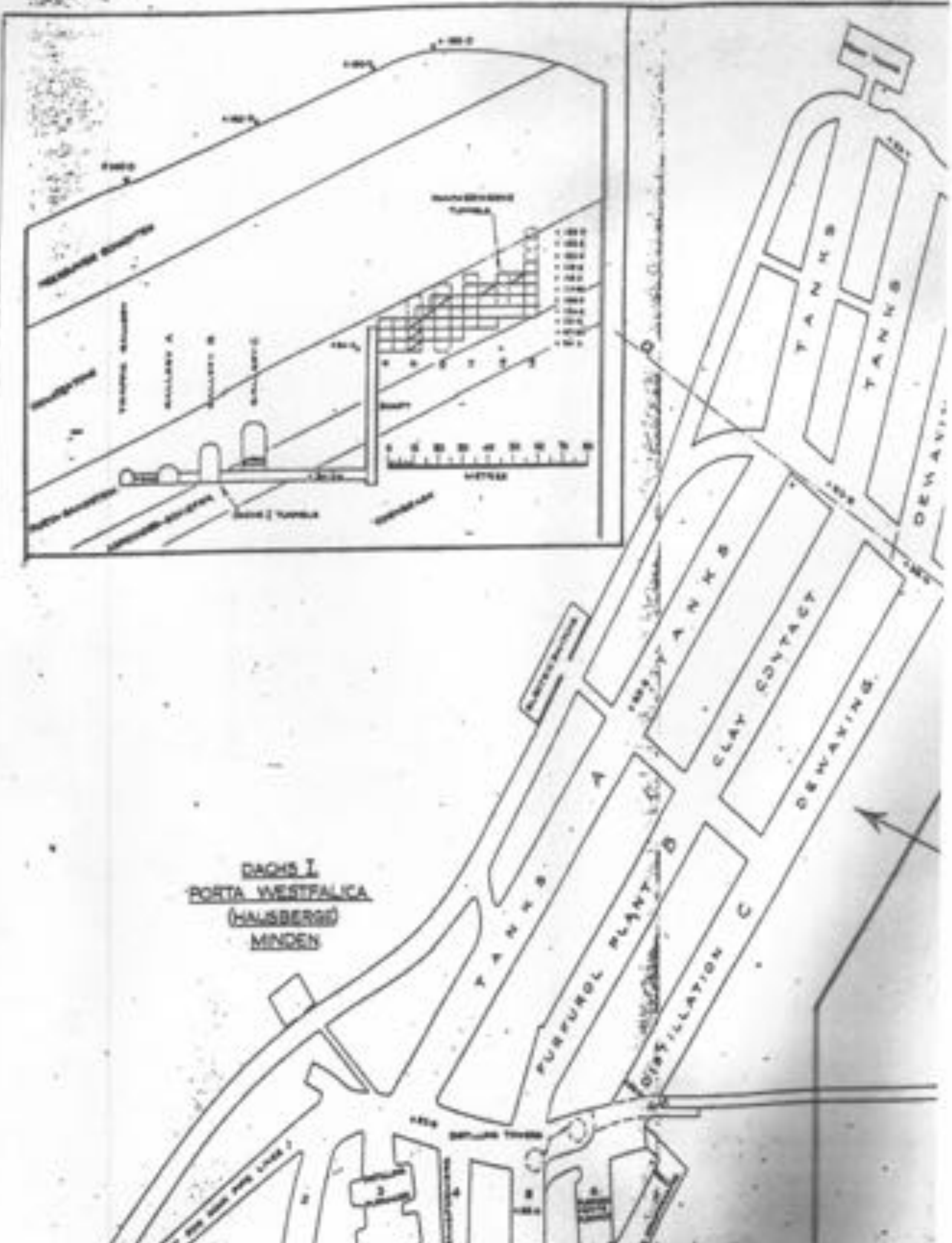
Denkmal Stollen, Barkhausen.

Entrance to factory, showing blast wall.

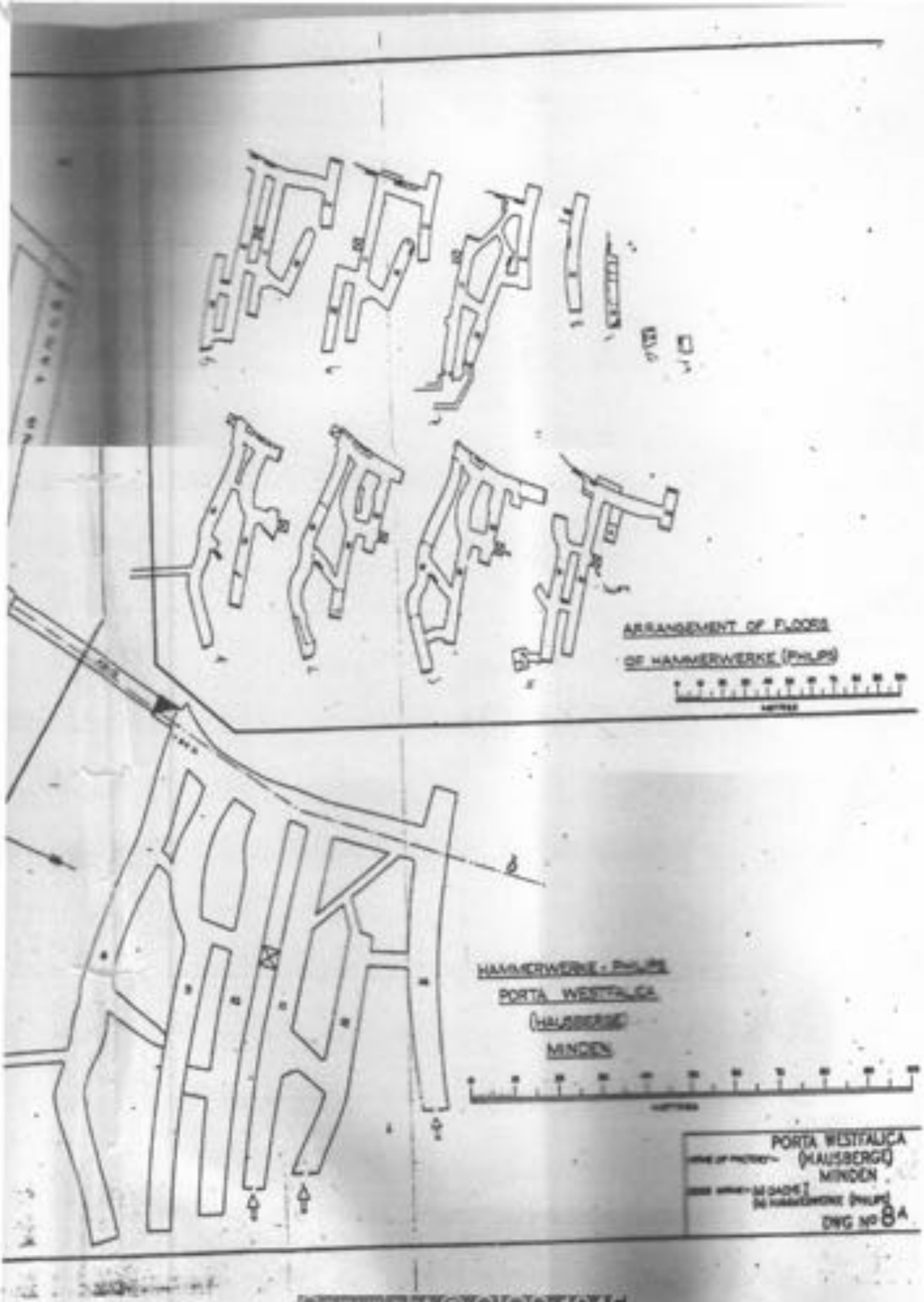
PHOTOGRAPH No.21.

Denkmal Stollen, Barkhausen.

Outcrop of Porta sandstone showing dip.



DACHS I.
PORTA WESTFALICA
(HAUSBERGE)
MINDEN



NAME OF FACTORY – PORTA WESTFALICA (HAUSBERGE) MINDEN

CODE NAME – (a) DACHS I
(b) HAMMERWERKE (PHILIPS)

DWG Nº 8A